DISCUSSION AND CORRESPONDENCE

THE DISCOVERY OF CACULUS

TO THE EDITOR OF SCIENCE: The writer desires to call attention to certain disclosures here pointed out for the first time, whose conclusions are decisive in the matter of the celebrated controversy between Newton and Liebniz, regarding the discovery of calculus. It is admitted that Leibniz was in full possession of his calculus, at the time of his second visit to London, in September, 1676, and that during the week in London, he made copious extracts from Newton's "De Analysi Æquationes Numero Terminorum Infinitas," which was in the hands of Collins, where it had been placed by Barrow in 1669, with the consent of Newton.[1] Besides containing the binomial theorem, expansions of trigonometric functions, etc., it was a complete treatise on fluxions. Found among Collins's papers after his death, it was published in 1711.

Leibniz's first information *from Newton* that this work existed, and where it was to be found, came from Newton's second letter of October 26, 1676, which reached Leibniz some months later in Germany. I quote the "Encyclopedia Britannica" (Inf. Calc.) as to the contents of this letter:

> Newton proceeds to state that about 1669 he communicated through Barrow to Collins a compendium of his method subsequently called "the method of fluxions," with applications to areas, rectification, cubature, etc. *In* this letter, however, he gave no explanation of this method, carefully concealing its nature in an anagram of transposed letters. . . .

Leibniz's reply to this letter has been termed one of "noble frankness" in contrast to Newton's secrecy. This frankness, however, did not consist in informing Newton of the week but recently spent with Collins, in careful examination of the very compendium to which he referred, and that his anagram was useless. On the contrary, Leibniz renewed statements of ignorance of Newton's method, and with seeming frankness, imparted his calculus to Newton in every detail, thereby laying the foundation of a plot to deprive Newton of all credit, whose subsequent details were carried out on a timed schedule.

Thus, on the first publication of a work on fluxions by Newton in 1704, an unsigned and unfavorable review in the "Leipzig Acts" for 1705, stated that Newton uses and always has used fluxions for the differences of Leibniz. A few years later, Leibniz, who was the author of this indirect charge, made it still clearer in a letter to Count Bathmar, which was published, stating that Bernouilli had written to him that Newton had apparently fabricated his calculus after having seen his own. Later than this, again, a letter was distributed over Europe, making the same direct charge, but without containing the name of its author, printer or place of publication.

From Leibniz's examination of Newton's compendium of fluxions on his second visit to London, it is absolutely certain that he possessed personal knowledge that these infamous charges against Newton were false.

It must be explained how Leibniz knew of the existence of that compendium in Collins's hands when he went to London, out of his way from Paris to Hanover, and how he knew that it contained what he wished to see. Newton's first letter to Leibniz, June 13, 1676, gave all the important theorems on series which were contained in that compendium, although his letter neither stated this fact, nor gave explanations. In his reply of August 27, 1676, Leibniz expressed great interest, and asked for their explanation and then shortly after went to London and read all about them, the opportunity for this journey being a request from the Duke of Hanover to return to Germany.

The only reasonable supposition is that Leibniz had seen this manuscript on his first visit to London, in 1673, and thus knowing of its existence, and that it contained these series, the new interest which they aroused caused the second visit, for the purpose of re-reading them in the light of an improved mathematical knowledge.

The probability of the truth of this supposition is increased when we take into account the character of the man and the cir-

[1] Cajori, "A History of Mathematics," p. 230.

cumstances which surround the first visit. He was continually employed throughout life in typical German propaganda, and was accustomed to political deceit. In 1669, under the guise of a Catholic Polish nobleman, he wrote a tract which undertook to mathematically demonstrate to his supposed countrymen, the Poles, that it was for the best interests of Poland to elect the German candidate for their throne. The political mission which brought him to Paris in 1672 was to secure France as an ally of Germany in a proposed war of conquest against the Turk, the bait to France being the possession of Egypt, "one of the best situated lands in the world." This project was finally laughed from the court of Louis XIV.

While in Paris, Leibniz corresponded with Oldenberg and Collins. The former was Secretary of the Royal Society of England, and had in charge all papers and manuscripts of the society. He was for many years a German agent in London whose services as secretary were given without pay. Confined in the Tower as a spy in 1669, the Royal Society adjourned its meetings until his release.[2]

Collins was the closest friend of Newton, and spent his entire time in obtaining the latest mathematical information and in corresponding with mathematicians about it. These two men, Oldenberg and Collins, always appear as instruments of Leibniz in his dealings with London affairs and with Newton, but all communications seem to have passed through Oldenberg's hands.

After 1669, when Collins obtained the compendium of fluxions above mentioned, there was much correspondence about fluxions between Newton, Collins and other mathematicians, and on December 19, 1672, Newton sent a letter to Collins which was designed to explain fluxions to any intelligent person, with one illustrative example, which Collins immediately began to communicate to all of his correspondents.

Leibniz was in London, January 11, 1673. and remained until March following. Application for membership in the Royal Society had preceded him, and he attended all of its meetings, read mathematical papers before it, and made claim to a differential method for series as his own invention, which Pell identified as the method of Mouton, a Frenchman, very much to Leibniz's discomfort. He had discussions with Oldenberg and Collins regarding series, and we must remember that the latter possessed, in Newton's compendium on fluxions, the latest and most remarkable series of the time. That Leibniz had free access to the manuscripts in the hands of these men, and read them, would appear from his notes of this visit, discovered in 1890, in the royal library at Hanover. These show extracts from Newton's "Optics," and from other authors, and a remarkable absence of notes on mathematics, his chief subject of interest at the time.

Returning to Paris in March, Leibniz placed himself under the guidance of Huygens in higher mathematics, and began the development of his calculus. It was well in hand by December, 1675, and the question arose, how to deal with Newton. The plan adopted was to have Newton informed that Leibniz had heard that he had a method for series, tangents and the like, and requested information about it, as he had one of his own. It required the united persuasions of Oldenberg and Collins, and an appeal that it was for the honor of England, to overcome Newton's objections and bring about the first letter of June 13, 1676, already mentioned. The ostensible purpose of the correspondence is to learn Newton's method, yet he held Newton's compendium of it in his possession for a week, the following September, and since its pages were opened freely to him at that time, it is constructive proof that they were as freely open to him for the two months in 1673 that he was in London.

The sudden death of Oldenberg in 1677 prevented an answer to the letter of "noble frankness." but when the "Principia" was published in 1687, Newton inserted a scholium containing the statement that a letter from Leibniz had shown that that distinguished

[2] See Weld, "History of the Royal Society," Vol. 1, pp. 201, 259.

man had fallen upon a method which scarcely differed from his except in its forms of words and symbols.

It is not known how far Collins was in the confidence of Leibniz, but it has been noted that following Collins's death in November, 1683, appeared the *first publication* of Leibniz's calculus, in the "Leipzig Acts" for 1684, essentially as it was given to Newton in 1677.

Additional force is given to the supposition that Leibniz saw Newton's compendium in 1673 by the similarity of the circumstances to those which relate to German propaganda as it has been disclosed by the recent war, a similarity so striking, that one hardly realizes that the period concerned is practically two and one half centuries nearer the origin of such methods. But the letter of "noble frankness" with the unquestioned facts which throw light upon it, are alone sufficient to bar Leibniz from the honor of an independent discoverer, for no other reason than that, as we say in the law, he does not come into court with clean hands. ARTHUR S. HATHAWAY

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THE POOR DIENER

How many of us have not felt as we closed an article that we may have thought good, perhaps expressing perfunctory thanks to our patron or instructor or some other figure in the seats of the mighty who took a few minutes time to send us some preparations or cultures prepared by some one else in his laboratory, that there was a hardworked, somewhat pathetic humbler figure back of it all to whom our thanks are far more due than to any of these?

When you take down from the shelf a carefully cleaned, carefully sterilized, cotton-plugged flask and fill it up for your own purposes, and then cheerfully discard it and take another because you got in a tenth of a centimeter too much, when you finish up a couple of hours brisk work and then carry out a trayful of pipettes to the "dirtroom" to be washed up, and leave around a staggering array of dirty glassware too bulky to bother to take out yourself, when you pile up on the sterilizing bench a great lot of used, gone and forgotten cultures for some one else to autoclave, then remember the poor diener.

When you toss over a foul sample of sputum with a "Here Jim, stain this up and look for the bugs," or hack out a bloody mess of tissues from a dead guinea pig and hand them over with a curt "Shove these into Zenker, George, and run 'em through as fast as you can," give credit where credit is due. These are not operations that can be carried on by any old man in the street; these are true science.

Dozens of procedures which we learned with difficulty in school days, we turn over to dieners and technicians, who learned the art from other dieners and technicians and carry it on in a clean-cut mechanical way better than we could do ourselves. God help science if all the dieners should unionize and go on a strike to-morrow. E. R. L.

SARANAC LAKE

SCIENTIFIC BOOKS

RECENT PALEOBOTANY IN GREAT BRITAIN

THE following survey of paleobotanical researches published in Britain during the war is necessarily superficial; it is, moreover, obviously impossible to draw a clearly defined line between work done in the period immediately preceding the outbreak of hostilities and work completed since August, 1914. No mention is made of papers which, though primarily concerned with recent plants, include references to extinct types. In spite of the fact that national work of one kind or another has absorbed, wholly or in part, energies normally devoted to scientific research the record of achievement amply justifies the statement that the progress of paleobotanical enquiry has not suffered any serious check. Much has been done towards quickening the spirit of research in pure science as well as in relation to problems of great economic importance: the foundations of paleobotanical knowledge have been considerably strengthened and, with the access of greater opportunities and revived interest in research which we confidently expect in the days to come, the results gained during the period of storm and